RETHINKING THE TEACHING OF THE HISTORY OF SCIENCE

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ABSTRACT

Difficulties face teachers of the history of science because of the increasing diversity of their students' scientific, ethnic and religious backgrounds and professional and academic aims. At the same time, the trend towards European convergence is encouraging a radical review of European universities' curricula in the history of science. Some reflections are presented and possible ways forward suggested.

This paper is about the teaching of the history of science at university level, particularly as a supplementary subject for students who will not become specialists in the history of science. It is based on personal and subjective observations and on the experience of designing and presenting a course unit, "Science 1500-2000", open to undergraduates at the University of Southampton.

Teachers of the history of science are faced by various challenges as a result of the diversity of their students. In European universities we find not only more ethnic and religious diversity but also an apparently increasing spread in students' professional or academic aims, in their degree of commitment to science as an ideal, and in their level of prior knowledge of science and of history. In the case of Britain there are clear social and educational reasons for this trend, and we should not be surprised to be faced by still more diverse groups of students in the future.

Not that student diversity is not to be seen as a problem in itself: quite the reverse. The problem is the teacher's, whose task it is to devise courses which will be interesting, truthful, challenging and relevant to all students. Moreover, student diversity is only one side of the problem: while student groups are changing, so also is the subject of the history of science itself. As examples of how the subject is evolving, one need only mention how European integration is encouraging the continuing withdrawal from nationalistic presentations of the subject, or how the history of "pure" science is increasingly seen to be inextricable from that of religion and ideology in general.

Science itself is also changing in subtle ways. It can be claimed that it is losing its old integrity and that students no longer have the idealistic commitment to science that was common a generation ago, although they may be idealistic about other things. A university teacher can no longer assume that students will regard science as a universal enterprise of transcendent value and importance. To point this out is not to regret the retreat from naive scientism as a philosophy, nor is it to claim that the teacher of the history of science should be trying to restore the status of science: but the teacher must come to terms with groups of students whose preconceptions about science, at a deep level, are very mixed.

As an example, over the past five or ten years there have been distinct changes in attitude among the practising science teachers who study for part-time Master's degrees in education at

the University of Southampton. Old commitments to scientific disciplines have been eroded, and science is commonly seen, even by teachers of science, as merely a servant of technology and industry. Recent changes in the school science curriculum encourage interdisciplinarity, practical applicability, an emphasis on method rather than content, and a self-perception among teachers in schools as being professional educators rather than scientists. Identifiable role-model physicists, chemists and biologists are gradually disappearing from schools, and the concept of a scientific discipline is becoming less tangible to students.

In universities, another trend is the expansion of young (or reinvigorated) scientific disciplines such as oceanography, psychology, nutrition and computer science. The list is a long one. From a student's point of view, the old classic disciplines such as physics can appear remote and obscure, and it is no longer clear why physics or astronomy should be taken as methodological paradigms for science as a whole.

Going further, it is often said that science today is very seriously discredited and that we are surrounded by a california of rational and irrational ideas and attitudes, some good, most bad, reminiscent of the ideological confusion of Rudolf II's time. This is most marked in the East, where neither science nor conventional religion but a smorgasbord of superstitions seems to be filling the intellectual vacuum created by the collapse of Marxism. This makes it more difficult but all the more important to convey the lessons that can be learned from the history of science, spotlighting especially the areas where science can tell us profound things about the universe and peoples' place in it. To isolate science from cosmological thought in general seems no longer helpful, if indeed it ever was.

One response to all this is to present a history of science which emphasises developments in how science is perceived and supported. To build up students' understanding of the issues involved, it is obviously useful to explain how science was perceived in the past. In the Victorian English context, for example, the teacher can contrast the Darwinians' expansive use of evolutionary scientific ideas with the view of John Henry Newman, who saw scientific disciplines as strictly circumscribed to avoid any possible conflict with religion or human values. Another example familiar in the English context is the contrast between 18th-century Newtonianism and the opposition to it represented most vividly by William Blake. In a course looking at these issues, it is fundamental that "science" meant different things at different times, and the question of definition itself must be made a facet of the course.

Some historians of science, however, may dislike a teaching strategy which emphasises the definition, functions and perceptions of science at the expense of the technical content of it, feeling that it is too easy to slip into teaching a sort of history of epistemology. Surely a course on the history of science should have, at its core, a substantial description of scientific knowledge itself as it stood at different times in the past? Here again, though, there are obvious and very familiar difficulties in dealing with heterogeneous student groups. A biologist is likely to have neither interest nor mathematical competence in the history of quantum mechanics, while a physicist may fail to see that that the history of medicine has any relevance to science as he understands it.

A conceivable solution is to teach different histories to students attached to different disciplines. It is not uncommon to have courses in the history of biochemistry for biochemists, say, presented as a kind of professional initiation, like young army officers being taught their regimental traditions. However, to atomise the history of science in this way is not only intellectually suspect; it is also economically difficult to provide separate courses on the history of science for chemists, mathematicians, oceanographers and so on, because the academic staff resources will simply not be available in any but the largest of universities. Commonly, it is possible to provide only one or two undergraduate course, which must perforce be designed to meet at the same time the needs of students specialising in many different disciplines.

So, how can a course in the history of science be designed to serve effectively students whose major interests are in a diversity of scientific and semi-scientific disciplines? One can reduce the time spent in plenary lectures, in favour of individual reading, small-group tutorials and individually-selected coursework. This supposes a style of university education depending on substantial library facilities and plenty of personal tutor-student contact, looking somewhat old-fashioned in today's age of rising student/staff ratios and diminishing resources. Alternatively, a modern solution might lie in the spread of arrangements for credit transfer between institutions: specialised courses in the history of science could be provided efficiently on an national or even international basis in the form of intensive short courses or possibly through distance learning techniques. This possibility will be mentioned again towards the end of this paper.

If a mixture of scientific disciplines poses educational problems for the teaching of the history of science, what about making the subject accessible also to specialists in non-scientific disciplines? How effectively can this be done? Can the history of science be taught to those with no grounding in science or mathematics? The traditional response to this issue has been to limit the historical treatment to earlier times - up to the beginning of this century, say - with the unstated and dubious assumption that the content of pre-twentieth-century science poses no technical difficulties for a university student of well-rounded background; but there is a serious danger here that students will be encouraged to perceive early science as being simple science, as if the history of science were mirrored in the school science curriculum by some bizarre principle of recapitulation.

The only solution is to retreat from the position that the history of science should entail an understanding of the substance of science. This takes us back to something touched on earlier, namely a presentation of how science has been perceived and used in the past and how it has interacted with other areas of human culture such as literature. A course of this sort can be interesting and accessible to non-scientists and can provide a valuable appreciation of the importance of science in human culture generally.

At the University of Southampton, the undergraduate course unit on the history of science is open not only to scientists and mathematicians but also to students in the Faculty of Arts, and it makes use of prose and poetry from a variety of writers including some obvious ones (e.g. John Donne and William Blake) and some less obvious (e.g. H.G. Wells and Primo Levi). Of course there is nothing new about using literature in teaching the history of science, but I would like to stress how valuable it is with students who are more at home with literature than with mathematical or chemical equations, and with whom it is possible to analyse literary material in some depth, not just using it for illustrative purposes or light relief. And what is true for literature is also true, of course, for the other art forms that have reflected scientific ideas in the past.

Although the history of science may be presented in an interesting and relevant way to non-scientists, it is important to resist the temptation to use the history of science as a way of teaching a bit of science to specialists in the arts and social sciences. If we use history as sugar on the pill of science, we can easily end up with bad history and bad science. If arts students are to be taught an appreciation of science itself then there are more direct and effective ways of doing it without recourse to history. But that is another story.

These comments bring us close to the central question of the purposes of teaching the history of science. There are three distinct purposes served by the course at the University of Southampton. Firstly, the subject teaches students about **science**, showing how it has emerged and evolved, and putting today's science into a historical context which makes it more comprehensible as a collective human enterprise. Secondly, it teaches a little bit of **history** (principally post-medieval European history) from a distinctive point of view which is valuable at least as a counterbalance to other approaches to history; for scientists and mathematicians it may be their only exposure to historical study in higher education. Thirdly, the subject is an

invaluable opportunity for science and mathematics undergraduates to read, discuss, form opinions, and write at length. In other words, science students have a chance to develop different **skills**. For many, it provides a refreshing experience of a kind of academic work which - in the English system - many will not have previously taken beyond the age of sixteen.

So far we have considered the challenge of teaching the history of science to students of different scientific disciplines, and to groups of mixed scientists and non-scientists. Ethnic and religious diversity presents other problems. For young students whose backgrounds are non-European or non-Christian, notions of the Renaissance, the Reformation or the First World War may be hazy. And yet, there is a recent and important textbook on the Scientific Revolution in which the first paragraph of the first chapter takes it for granted that the reader already knows the political significance of 1689 and 1832 in England and 1789 in France. Can that really be counted upon among our students now? Religious concepts likewise present increasing difficulties. Northrop Frye's classic study, "The Great Code", claimed famously that the Bible is the real basis of all English literature: likewise it could be claimed that theology is the real basis of European science, but many of our students today lack the background knowledge even to approach such questions.

Issues like this arise in the teaching of history generally, not just in the history of science, and there is much activity and controversy in the devising of non-Eurocentric and cross-cultural history curricula. The question for us is whether we can attempt something along those lines for the history of science. There are some deep and difficult issues here, on which researchers in the subject already disagree, and on which teachers as a profession may be unable to reach a consensus. How European is science? Was the Greek achievement unique? Is the relationship between science and Christianity an essential one or an accidental one? Can mediaeval science be disentangled from mediaeval Christianity? Globally, how significant was the "Scientific Revolution"? Historians of science are temperamentally reluctant to take stands on cosmic questions such as these, but it is hard to see how the subject could be radically recast without providing answers.

To produce a Europeanised presentation of the history of science, if not attempting a worldwide synthesis, other awkward questions arise: do British historians overemphasise Darwin? Do Protestants overvalue the Reformation? Do Christians underrate the importance of Jewish Cabala or of Spanish Islam? Should we not draw lessons from the history of science in minor regions (so to speak) like Bohemia? Why are figures like John Eriugena so neglected?

In conclusion, based on all that has been said above, one or two proposals can be made for the future teaching of the history of science. Courses should be developed that can be presented as intensive short courses or through methods of distance learning, so that students can be drawn together on national and international scales. This already happens in better-funded disciplines where the economic benefits are more obvious than in the history of science. Already, arrangements are being made to provide the course mentioned earlier in this paper, "Science 1500-2000", as an open-enrolment two-week residential course around Easter 1994, but much more will be needed. This should go hand in hand with curriculum development towards a European synthesis of the history of science, tackling afresh the kind of questions mentioned in the previous paragraph.

However, such activities will require a level of collaboration in course design unusual among historians of science. There will be costs involved, and it will be necessary to justify the subject convincingly so as to attract sufficient support. To do that, the point must be made convincingly that the history of science should have a very special place in European cultural consciousness. It is a discipline which can unify us while rejoicing in diversity. It should form the basis of the public understanding of science, informing scientific and technological policy and helping to counter the growth of irrationality and pseudoscience by which the 20th century could so easily be betrayed in the 21st.